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The Chronicles of a Dying Giant: Spatio-Temporal Autopsy of Timber Exploitation and Forest Degradation in Cross River State (2000–2020)

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[0157] Abstract

Timber and forest resources is on high market demand for domestic, commercial, economic, industrial, and pharmaceutical purposes globally. The spade of timber and forest degradation in recent time have assumed unprecedented dimensions in Nigeria and particularly Cross River State, Nigeria. This study conducted a spatio-temporal autopsy of timber exploitation and forest degradation trends from 2000 to 2020, examining the magnitude and drivers of deforestation in Cross River State. The study utilized Remote Sensing (RS) and GIS approach to analyze the scale of changes in forest cover in both Akamkpa LGA, which are notable for harbor of largest forest reserves in Cross River State. Data were obtained majorly from secondary sources from Cross River State Forestry Commission, environmental reports, peer reviewed articles and journals and were integrated to examine the pattern of forest degradation as well as the socio-economic factors driving timber exploitation. Result from the analysis of the remote sense and GIS data revealed a gradual but alarming rate of forest depletion from 2015, with an unprecedented increase in deforestation between 2019 and 2020. The drivers of the forest degradation were; intensified illegal logging, weak enforcement of conservation policies, and increasing demand for commercial timber products. The findings further revealed that a very large expanse of forest in Akamkpa LGA have suffered intense degradation, while forest cover declined by over 60% in some locations. There is need to revisit the forest regimes and strengthen the regulatory frameworks, afforestation programs, and community-based conservation strategies to mitigate further forest biodiversity loss.

Keywords: Cross River State, deforestation, Forest degradation, spatio-temporal analysis, timber exploitation,

Introduction

Background to the study BacForests is ranked among the highest natural ecosystems that provides significant services which include; sequestration of carbon, climate regulation, conservation of biodiversity, among others (Sarkar, *et al.,* 2024). Despites the contributions of forests to the global economy and human sustenance, there are continuous act that degrades the forests such as illegal logging, urban sprawl, agricultural extension, infrastructural development (Maurya, & Vivek, 2025). The spade of world's forest loss in the past two decades has increased tremendously (Nambiar, 2021).). The tropical regions, has suffered forest lost and is ranked the most affected between 1990 and 2020, as report indicates that approximately 420 hectares of world's forest was lost (Debebe, *et al.,* 2023). Forest loss in Brazil, Indonesia and the Democratic Republic of the Congo (DRC), has assumed an alarming rate and this is due basically to unsustainable timber extraction, encroachment and illegal logging (Muheirwe, 2023). The rate of forest lost continues unchecked and threatening forest biodiversity and rural socio-economic livelihoods, despite different conservation initiatives globally, such as REDD+ and the Paris Agreement (Shah, & Race, 2024).

Congo Basin is within the tropical rainforest ecosystem in Africa that affected by protracted deforestation due high demand for timber products and agricultural land (Tari, *et al.,* 2024). Recently, there

has been unprecedented loss of forests in the DRC, and this have resulted to loss of biodiversity and increase poverty as most rural residents depends on forest resources for their livelihood (Mondo, et al., 2024). Another scenario of rapid forest lost and degradation are the Ituri Rainforest in the DRC and the Atewa Forest in Ghana (Adom *et al.,* 2024). The rate of deforestation in most African countries and degradation is largely due to weak regulatory frameworks and poor enforcement of environmental policies. Illegal logging, fueled by international demand for exotic timber, has further exacerbated the crisis, pushing many species toward extinction and disrupting local climate patterns (Singh, 2024).

In Nigeria, the rate at which the forest is disappearing has reached critical levels, with an annual forest loss rate of approximately 3.7% one of the highest in the world (Udoh, *et al.,* 2025). All the forest reserves in Nigeria are severely impacted illegal and over-exploitation of timber products, agricultural activities and infrastructural development. Typically, Omo Forest in Ogun State have witnessed vagaries of degradation due to unsustainable harvesting of timber products (Oyedepo, & Ogunsesan, 2024). Several efforts and initiatives by the government to mitigate deforestation through afforestation and reforestation programs are mere lip-service as their policies have yielded minimal success due to poor enforcement and corruption in the forestry sector (Ajij, 2024). Moreover, growing population and urban expansion have exerted much pressure on Nigeria's forests ecosystem, making sustainable forest management a major challenge.

Cross River State is home to Nigeria's largest remaining tropical rainforest, accounting for over 50% of the country's forest cover (Erim, *et al.,* 2024). The state's forests, particularly in Akamkpa and Boki Local Government Areas (LGAs), have historically been conservation strongholds (Ndem, et al., 2025). However, timber exploitation and land conversion for agricultural purposes have led to massive forest loss over the past two decades. The Cross River National Park and Afi Mountain Wildlife Sanctuary, which harbor rare and endangered species such as the Cross River gorilla (*Gorilla gorilla diehli*), have been significantly degraded due to uncontrolled logging activities, road infrastructure development (proposed super-Highway) and farming activities (Oko, et al., 2024). Spatio-temporal analysis reveals that the peak of deforestation is at alarming rate in the past two decades, with illegal loggers exploiting loopholes in environmental policies. This trend, if not checked, could lead to the near-total depletion of the state's primary forests.

Problematic Deforestation and forest degradation has in recent time threatened biodiversity richness in Cross River State, especially in Boki and Akamkpa Local Government Area. Despite the state being recognized as the ecological pillar of conservation for flora and fauna celestial specie in Nigeria, the rate of illegal logging and government mismanagement of the forest resources is a major concern. As demand for timber product keep increasing, weak government regulatory policies, poor enforcement of forestry laws, it has fueled widespread illegal logging and forest degradation in Akamkpa. Studies conducted by Bansah, et al., (2024), Somorin, (2010). & Chechina, et al., (2018), highlighted that from satellite imageries and direct field observation, that large expanse of the forest has been degraded and this has threatened the ecological balance and livelihoods of local communities. Furthermore, in Akamkpa, there are cases of the displacement of forest-dependent communities and the destruction of biodiversity-rich habitats are worsening environmental crises such as soil erosion, climate change impacts, reduction in the flora and fauna specie and migration of large mammals from the Cross River National Park to the Korrupt National Park in Cameroon.

Several scholars have conducted similar study in other clime and even within Cross River State, such as Daipan, & Franco, (2022) Spatio-temporal analysis of remotely sensed forest loss data in the Cordillera Administrative Region, Philippines. Hussain et al., (2024), Assessing forest fragmentation due to land use changes from 1992 to 2023: A spatio-temporal analysis using remote sensing data. Xu, et al., (2022), Analysis of spatio-temporal changes in forest biomass in China. However, there is still paucity of data on the spatio-temporal analysis of forest loss in Cross River State. Also, most of the existing researches did not holistically analyze the patterns, drivers, and socio-economic implications of unsustainable timber exploitation in Akamkpa and Boki LGAs. This study conducted a spatio-temporal autopsy of forest

degradation in Cross River State from 2000 to 2024, using remote sensing data, historical records, and field surveys

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2. Materials and Methods

Akamkpa LGA of Cross River State, Nigeria, which host significant portions of the state's tropical rainforest. Akamkpa LGA, located between latitudes 5.15°N and 5.55°N and longitudes 8.15°E and 8.50°E, is home to the Cross River National Park and extensive forest reserves and several community-managed forests. These areas have historically served as biodiversity hotspots but have faced extensive degradation due to logging, agricultural expansion, and infrastructural development. This study adopted a mixed-methods research design, integrating geospatial analysis with qualitative and quantitative data collection techniques. Secondary data on forest cover changes from 2000 to 2020 were obtained from Landsat satellite imagery, Global Forest Watch databases, and government forestry records. Primary data were collected through structured interviews with forestry officials, local loggers, and community leaders to assess the socio-economic drivers of deforestation. A stratified random sampling technique was used to select forested sites for ground-truthing, ensuring a representative coverage of degraded and non-degraded areas. The collected data were analyzed using remote sensing and Geographic Information System (GIS) techniques to map spatio-temporal patterns of forest loss.

3. Result and discussion

Findings from Key Informant Interviews (KII) on the drivers of forest degradation To identify the major drivers of forest degradation and timber exploitation in Akamkpa forest communities, interview was conducted with officials of the forestry commission and the Cross River National Park (CRNP) Oban Division. The argued that the spade of deforestation in Akamkpa LGA, has accelerated due to weak enforcement of environmental regulations and corruption within forestry management agencies. The rangers with the Cross River National Park, also opined that despite existing policy regimes aimed at sustainable logging, illegal timber extraction remains rampant, largely due to inadequate monitoring personnel and logistical constraints. Furthermore, respondents also noted that despite the afforestation initiatives to restore some degraded areas in the forest, they are poorly funded and lack proper implementation modules. Other respondents also pointed out that the site clearing for the proposed super highway, have contributed significantly to large expanse of forest loss, because the open access pave way for illegal loggers.

Findings from the interpretation of the local loggers complained that the resolve to cutting down forest trees is their major source of survival for their families, as alternative livelihood options are not provided. Meanwhile, other also asserted that they are into illegal logging because the cost of obtaining licence from the government is high and the process cumbersome, making legal logging unfeasible. Again, other respondents accused the state government of being complicit in forest destruction, stating that even some state authorities engage in indiscriminate logging for personal gains. Some loggers expressed frustration that while they are often blamed for deforestation, the government itself has been responsible for large-scale timber extraction, especially during the COVID-19 era between 2020 and 2021, when restrictions on movement provided cover for intensified illegal logging operations. The demand for timber from furniture industries and export businesses further exacerbated the situation, driving excessive deforestation without adequate reforestation efforts.

Furthermore, some community leaders in their response revealed a more revealing and worrisome drivers of forest degradation, emphasizing the social and ecological implications of forest degradation. Meanwhile, respondents from Akamkpa LGA, lamented the loss of traditional medicinal herbs, with a corresponding decline of non-timber forest products, and increased instances of human-wildlife conflict due to continuous habitat destruction. Some community leaders, who did not want their names in print, directly accused the Cross River State government of sponsoring illegal logging activities, particularly during the COVID-19 lockdown period when enforcement agencies were largely inactive. Moreover,

several respondents in Akamkpa LGA, expressed concerns over the gradual encroachment into the sacred forest sites, which hold cultural and spiritual significance for local communities. While some leaders have attempted to organize conservation initiatives, they stated that limited support from government agencies and lack of awareness among younger generations have hindered their success. Ultimately, they emphasized the urgent need for participatory forest management strategies that integrate community involvement with stricter enforcement of environmental regulations.

1.4.2   Forest cover change from 2000 to 2020
1.4.2.1   Maps of forest cover changes in Akamkpa LGA, from 2000 to 2020

The results of the land-use and land-cover (LULC) changes in Akamkpa Local Government Area (LGA) paint a concerning yet insightful picture of forest degradation trends over the past two decades. LULC maps (Fig. 1) reveal that while the level of forest degradation was relatively low in 2005 (See Fig 2), subtle indications of forest loss began to emerge, largely driven by illegal logging and the expansion of road infrastructure. By 2010, logging activities intensified, leading to a more pronounced depletion of forest resources as evident in Fig 3. This period saw significant encroachments into previously undisturbed dense forest areas, exacerbated by agricultural extension programs that encouraged the conversion of forest land into farmlands, thereby creating a fragmented area within the forest. The increasing demand for timber and agricultural products during this time, although beneficial for local economies, placed considerable pressure on the forest ecosystem, setting the stage for accelerated deforestation in subsequent years.

The situation became increasingly dire between 2015 and 2020, with the most devastating levels of forest loss occurring during the COVID-19 pandemic from 2019 to 2021 as seen in Fig 4 and 5. As economic activities came to a halt globally, local communities in Akamkpa, like in many forest-dependent regions, turned to illegal logging and unsustainable resource extraction as alternative means of livelihood (Basumatary, & Das, 2024). The LULC map of 2024 clearly depicts vast expanses of degraded forest and lost timber resources, signifying the compounded impact of economic desperation and weak forest governance during the pandemic era. Similar findings have been reported in other tropical forest regions; for instance, Useni Sikuzani, et al., (2024), documented a surge in illegal deforestation in the Amazon during the COVID-19 lockdown, attributing it to reduced monitoring and enforcement activities. The Akamkpa scenario aligns with this global pattern, emphasizing the urgent need for sustainable forest management practices, community-based conservation initiatives, and stronger policy interventions to curb future degradation and restore ecological balance in this biodiversity-rich forest area.

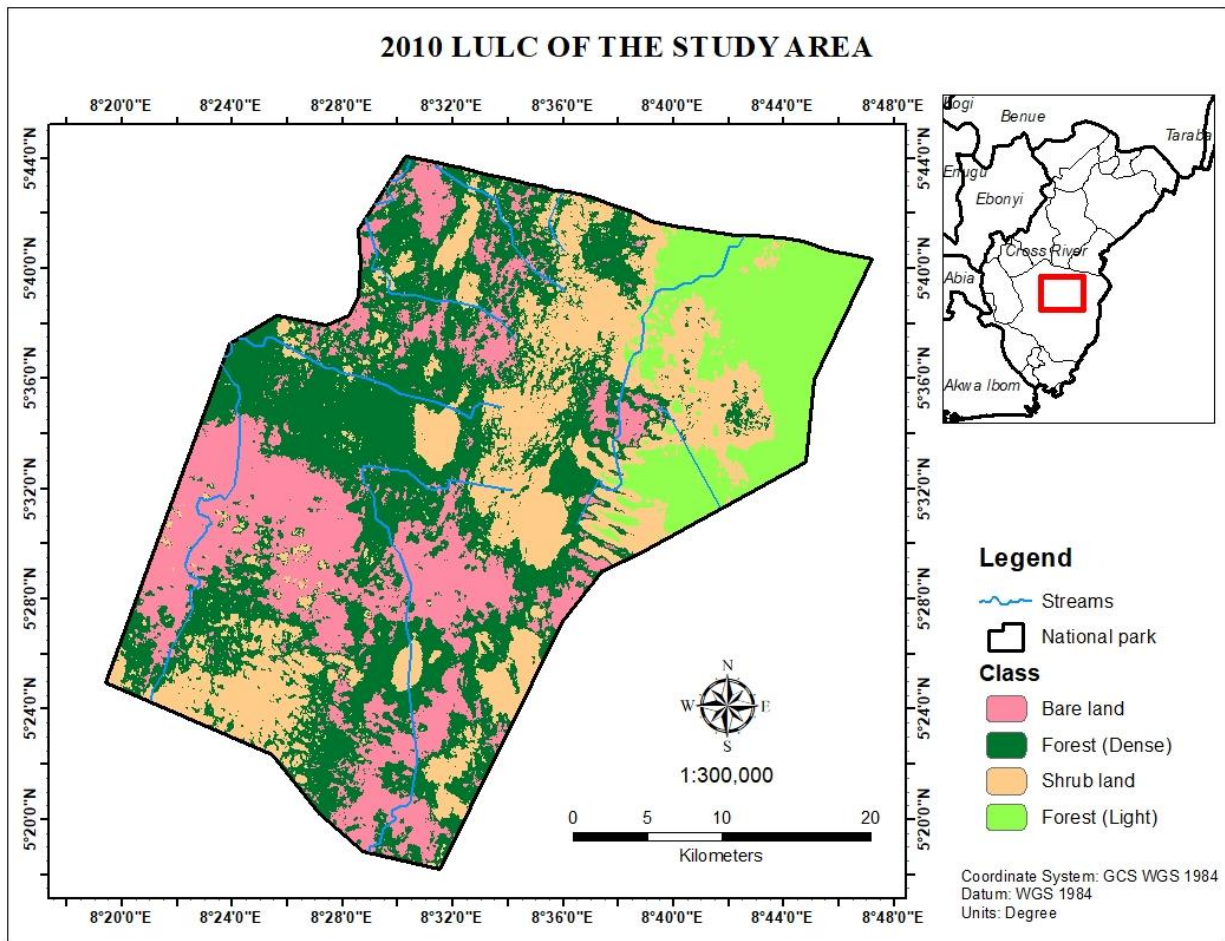**Fig. 1: 2000 LULC OF CRNP Oban Division**
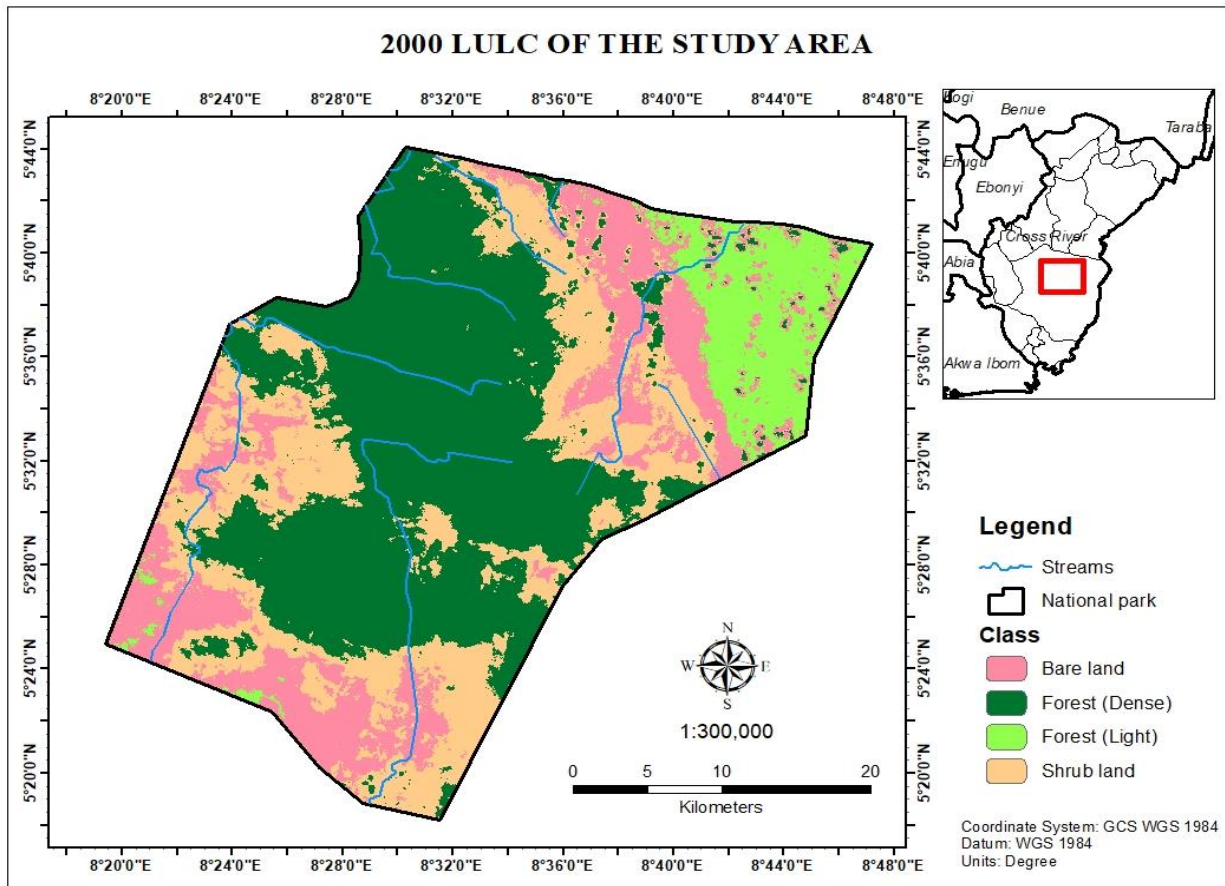
Source: Authors fieldwork, 2025
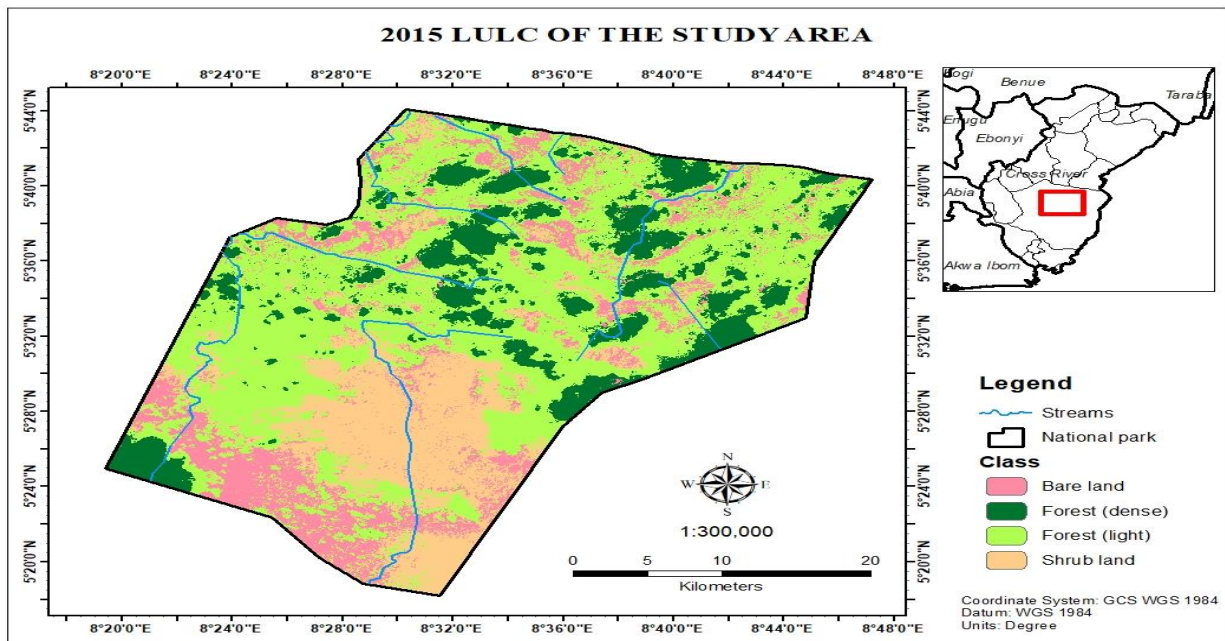
Fig 2: 2005 LULC for CRNP Oban division
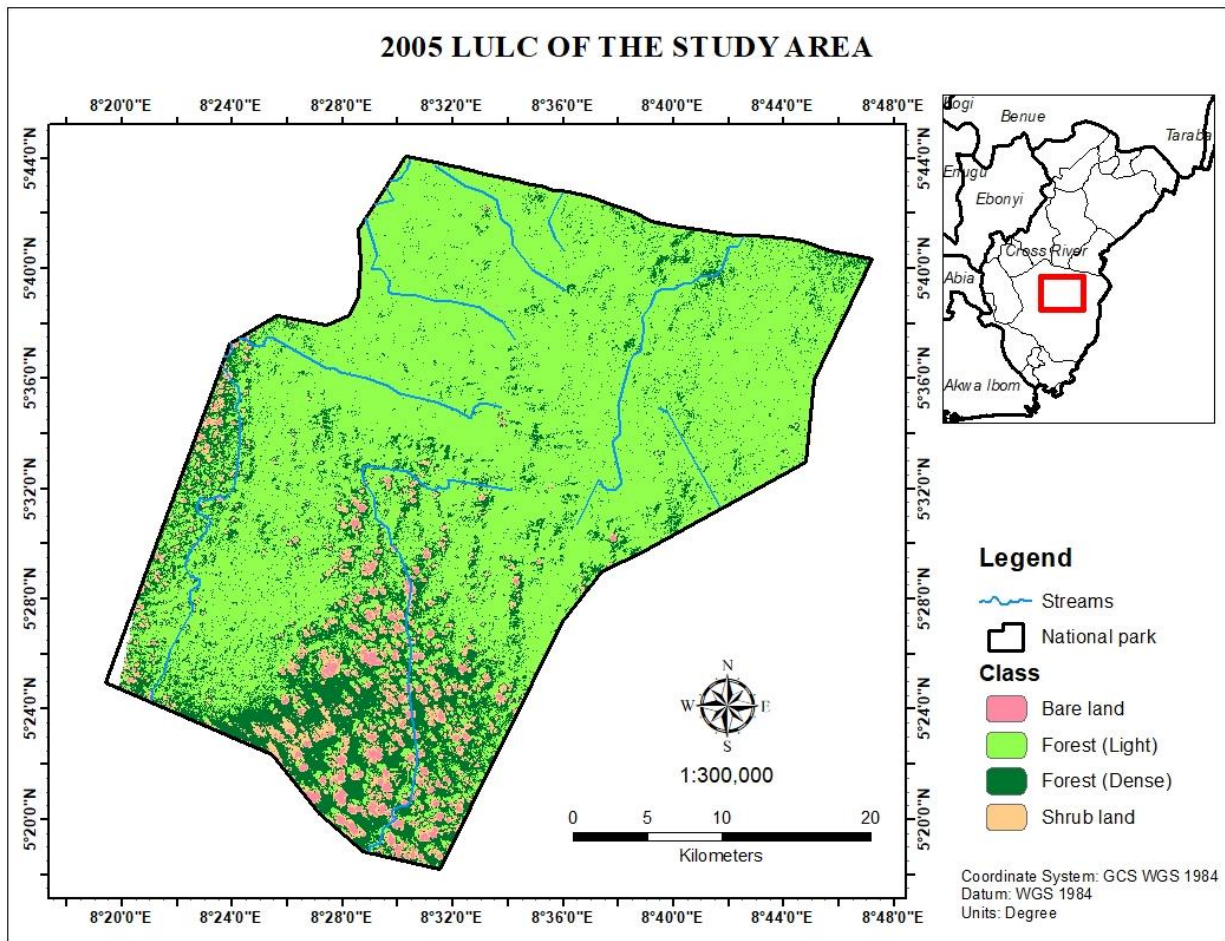
Source: Authors fieldwork, 2025
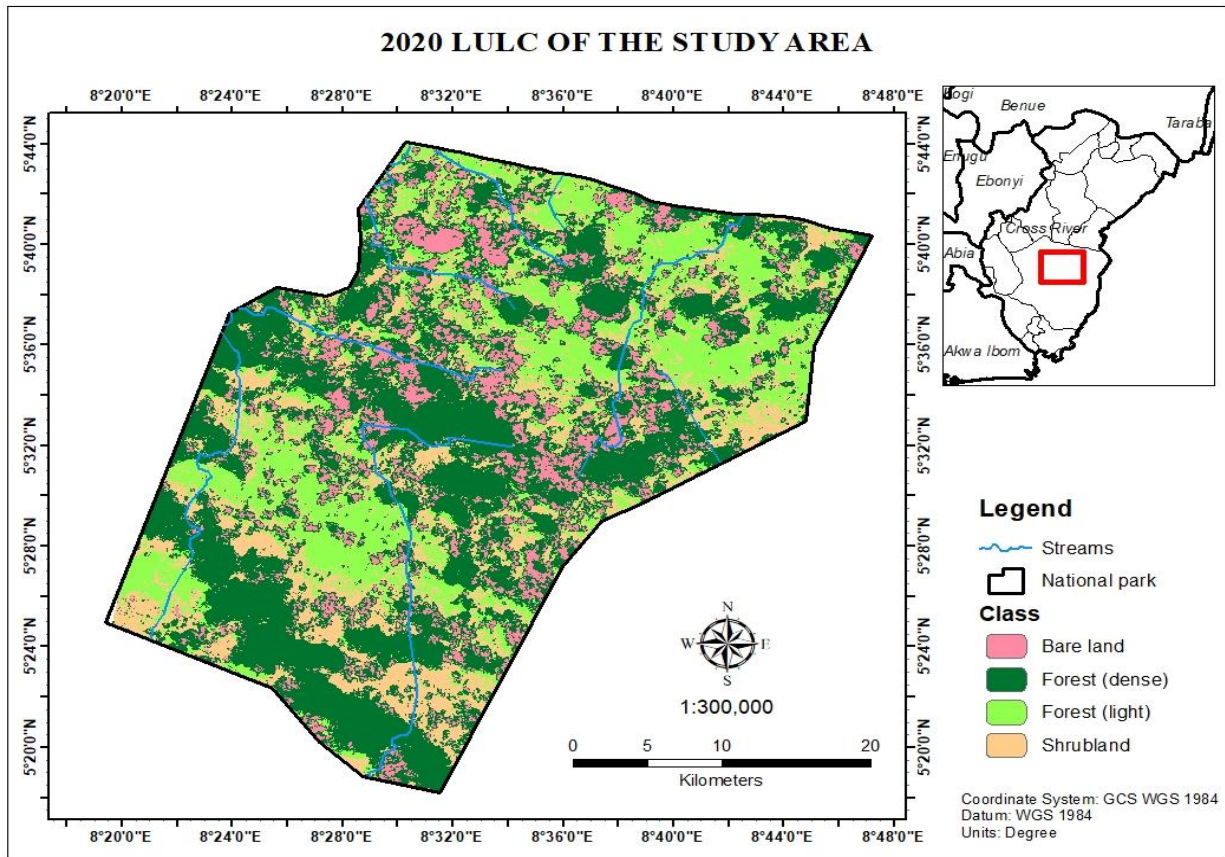
Fig 3: 2010 LULC of Akamkpa LGA

Source: Authors fieldwork, 2025

Fig 3: 2015 LULC of CRNP, Oban Division

Source: Authors fieldwork, 2025
Fig 4: 2020 LULC of CRNP, Oban division

Source: Authors fieldwork, 2025

Accuracy assessment

The thematic classification of land cover in Cross River National Park (CRNP) demonstrated a high level of accuracy, with an overall accuracy of 84.3% and a Kappa coefficient of 0.98, indicating a near-perfect agreement between classified and reference data. The classification accuracy was particularly strong for water bodies and mature secondary forests, both achieving 100% omission accuracy, while dense forests and tree savannas also showed commendable accuracy at 99.8% and 99.27%, respectively. Though young secondary forests and settlements had slightly lower omission accuracies of 88.2% and 87.2%, the commission accuracies remained consistently high across all habitat classes. These findings align with the work of Onuegbu, & Egbu, (2024). who reported similar accuracy levels in their land cover classification of Nigeria's protected areas, underscoring the effectiveness of supervised classification methods in capturing complex forest ecosystems and supporting sustainable management practices.

Table 1: Error matrix derived from thematic classification of land cover in the CRNP

	Reference data							
Habitat classes	Grassland savanna	Tree savanna	River	Young secondary forest	Denseforest	Mature Secondary forest	Settlement	Omission accuracy %
Grassland savanna	**99.6**	0.66	0	0	0	0	0	**98**
Tree Savanna	0.3	**99.27**	0.64	0	0	0	0	**99.8**
Water Bodies	0	0	**99.3**	0	0	0	0	**100**
Young secondary forest	0	0		**99. 06**	0.82	0	0	**88.2**
Dense forest	0	0.03	0	0.94	**98.94**	1.14	0	**99.8**
Mature secondary forest	0	0	0	0	0	**98.86**	0	**100**
Settlement	0.1	0.03	0	0	0.24	0	**100**	**87.2**
Commission accuracy %	**99.6**	**99.3**	**99.3**	**99**	**98.9**	**98.8**	**100**	

Kappa coefficient = 0.98	Overall accuracy = 84.3%

90.5% of the total area, with a mean class patch size (MPS) of 46.7 ha, indicating large, contiguous forested areas essential for biodiversity conservation. In contrast, the mature secondary forest, though covering only 4.5% of the park, exhibited the highest fragmentation with 57,002 patches and a significantly lower MPS of 0.05 ha, reflecting patterns of forest regeneration and anthropogenic influence. Similar findings were reported by Sapere-Obi, (2024). who observed dense forests forming core habitat blocks in Nigeria's protec

Class area and size metrics

The land cover class area and size metrics for Cross River National Park (CRNP) reveal a landscape dominated by dense forest, covering ted areas, while secondary forests and savannas showed higher fragmentation levels due to agricultural encroachment and logging activities. This alignment underscores the importance of continuous monitoring and habitat connectivity to safeguard the ecological integrity of CRNP.

Table 2: Land cover class area and size metrics

Habitat class/type	Habitat area (ha)	Habitat percentage area (%)	Number of patches (NumP)	Mean class patch size (MPS) (ha)	Median class patch size (MedPS) (ha)
Dense forest	69684	90.5	1447	46.7	0.02
Mature secondary forest	3458	4.5	57002	0.05	0.03
Tree savanna	1392	2.0	118	0.8	0.02
Grassland savanna	1240	1.8	1931	0.8	0.02
Water	312	0.5	2273	0.09	0.02
Young secondary forest	285	0.4	5779	0.05	0.02
Settlement	254	0.35	323	1.2	0.03

Summary of Findings

The findings from the study revealed that there is a drastic change in the land-use and land-cover (LULC) of Akamkpa Local Government Area, between 2000 to 2020. This is with substantial evidence of forest loss due to intense and illegal logging, agricultural encroachment and the site clearing of the abandoned super highway. The output from the analysis of figure 1, 2, 3, and 4 which is the LULC maps, highlighted that deforestation was relatively low in the early 2000s, but began to increase gradually as at 2005 and reached alarming rate by 2015, coinciding with intensified logging activities. By the COVID-19 pandemic period (2019–2021), the depletion of forest cover became pronounced, as economic hardship led to increased exploitation of forest resources, culminating in a significant loss of timber and biodiversity by 2020.

The spatial analysis demonstrated that dense forest, once the dominant land cover, experienced a considerable reduction, giving way to secondary forests, agricultural land, and settlements. The fragmentation of forested areas was reflected in the increasing number of small patches, particularly in mature and young secondary forests, signaling ecological instability and habitat loss. The study's accuracy assessment, with an overall accuracy of 84.3% and a Kappa coefficient of 0.98, confirmed the reliability of the classification, aligning with similar findings from tropical forest studies in Nigeria and beyond (Onuegbu, & Egbu, (2024).

The study further highlighted that the trend of forest degradation in Akamkpa poses serious implications for local biodiversity, carbon sequestration, and community livelihoods. Without

strategic intervention, the continued loss of forest cover could lead to irreversible environmental damage and economic challenges for the region's rural population. The alignment of these findings with global studies on tropical forest depletion underscores the urgent need for sustainable land management practices and strengthened forest conservation policies.

Recommendations

From the study findings, the following recommendations were reached; (a) The Cross River State Government, Forestry Commission, in collaboration with Cross River National Park and environmental NGOs, should implement stricter monitoring and enforcement mechanisms to curb illegal logging activities within Akamkpa LGA. (b) Local communities should be actively involved in forest conservation programs, with incentives to promote sustainable agricultural practices and reduce dependence on timber resources. (c) The Ministry of Environment should establish an ecological restoration plan, focusing on afforestation and reforestation efforts to mitigate the impacts of forest loss and habitat fragmentation. (d) Academic institutions and research bodies should conduct continuous LULC monitoring using remote sensing and GIS technologies to provide up-to-date data for informed decision-making and policy formulation.

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